Aircraft Primary Structure Adhesive Bonding Development

Status: Technical Success

PROBLEM / OBJECTIVE

Use of all-adhesive bonded primary aircraft structures has the potential to save significant weight and cost compared to conventional bonded-bolted designs. To-date, these structures have been avoided because of a lack of confidence in the ability to control manufacturing variables to the extent needed for all-adhesive bonded systems to meet Navy aircraft service requirements for these structures in the absence of mechanical fasteners. The objective of this project is to quantify the effects of defects and manufacturing process variability in order to improve the producibility and reliability of adhesive-bonded joints for primary aircraft structures.

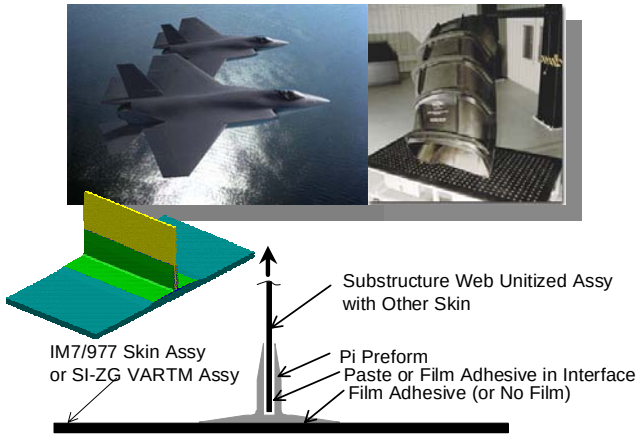
ACCOMPLISHMENTS / PAYOFF

Process Improvement:

This project has characterized the effects of process variables and manufacturing defects on the performance of adhesive-bonded joints. This includes the influences of nominal differences in materials, Pi-Joint design variations, assembly and bonding process variations such as adhesive thickness, offset web, poor surface condition, improper cure, and joint porosity. The data gathered from tests of more than 800 test articles has been assembled into a database that has been distributed to the Navy/Air Force and Composites Affordability Initiative (CAI) community.

Implementation and Technology Transfer:

Totally adhesive-bonded primary structures are applicable to fixed-wing aircraft programs such as Joint Strike Fighter (JSF), F-18, V22, and Joint Unmanned Combat Air System (J-UCAS). The results of this project were used by Lockheed Martin to support the design of JSF composite inlet duct. Project results were provided to the Composites Affordability Initiative to be used in the design, modeling, and analysis tools to impact the manufacture of the Joint Strike Fighter and future aircraft. Bonding improvements also can be applied to existing co-bonded structures and in repair.



Expected Benefits:

- Adhesive bonding technology could result in a 95% reduction of mechanical fasteners for a component such as the JSF composite inlet duct.
- Adhesive bonded joints with fewer fasteners benefit the warfighter by improving aerodynamic and signature performance, eliminating fuel leak paths and simplifing manufacturing assembly, all resulting in a more robust and affordable aircraft.
- The application of 3-D preforms to the JSF inlet duct could reduce the cost of the duct by at least $200,000 and save more than 80 lbs of weight.

TIME LINE / MILESTONE

Start Date: January 2001
End Date: July 2004

FUNDING

Total ManTech Investment: $1.925M
Voluntary Cost Share (Boeing): $0.79M
Voluntary Cost Share (Lockheed Martin): $0.72M

PARTICIPANTS

Edison Welding Institute (EWI)
Lockheed Martin Aeronautical Systems
Boeing Integrated Defense Systems
NAVAIR